Energy Facts

Utility-Scale Photovoltaic (PV)

Most people are familiar with solar panels on individual roofs. These panels are usually made of crystalline silicon and produce electricity to offset the use by the customer or owner "behind the meter." That is, whatever electricity customers produce with their solar arrays reduces the amount of energy they must purchase from the utility. In contrast, utility-scale PV, sometimes called "central station PV," acts more like a power plant, producing energy that the utility purchases and then distributes to customers.

Photovoltaic modules use a variety of materials that produce a photoelectric effect to convert sunlight directly to electricity. Traditional PV uses flat-panel crystalline silicon, but some companies are also developing concentrating photovoltaic (CPV) devices to reflect concentrated sunlight onto highly efficient photovoltaic cells. New thin film technologies employ cadmium telluride (CdTe), copper indium gallium diselinide (CIGS), and thin-film amorphous silicon. Depending on the technology, the panels are deployed on tracking devices to follow the sun, or simply arranged in long rows facing south (in the Northern Hemisphere). Central station PV is relatively new, so techniques and technologies are competing with no clear "winners" to date.

History:
The photoelectric effect has been known for over a century, since Einstein's theoretical explanation in 1904. The first commercial applications of PV technology were in satellites in the 1950s. Solar modules were first made in the 1970s and the first 1 MW plant began operation in Sacramento, CA in 1984. More recently, with advances in technology and favorable regulatory frameworks, large scale PV has been growing rapidly, especially in Germany and Spain. At the end of 2006, Germany had 300,000 solar power ar-

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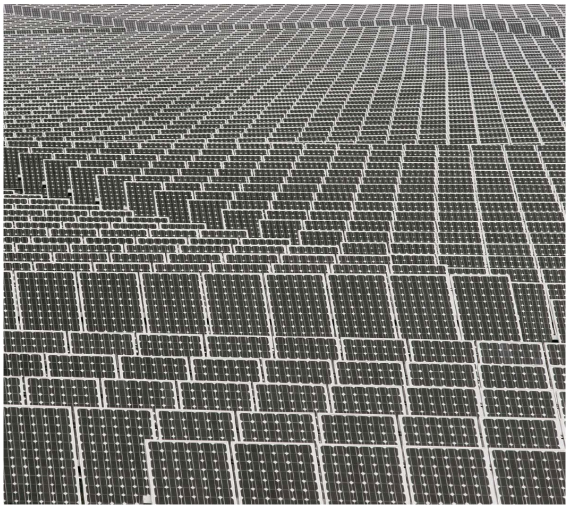
rays installed, totaling 2,300 MW.[1]



In North America, as of the close of 2007, over 252 MW of utility-scale PV contracts had been signed in Ontario where favorable policies are found.[2] In December 2007, a 14 MW project at Nellis Air Force Base (AFB) came online, the largest PV project in the US to date. In that same month, Southern California Edison announced an agreement to purchase energy from a 7.5 MW solar installation from First Solar, Inc, a manufacturer of CdTe panels.[3] On the CPV-side, Pacific Gas & Electric has signed an agreement with GreenVolts to build a 2 MW plant on eight acres of land in Tracy, CA.[4] OptiSolar, a CA-based independent power producer, has announced a 550 MW thin-film solar farm in San Luis Obispo that will begin construction in 2010. Although the technology is well proven, the price of PV has remained an obstacle to utility-scale deployment. With technological advancements in thin-film PV, as well as crystalline PV, the market may sustain multi-MW projects that can compete with conventional power.

Land Use:
Large-scale PV requires level land, with less than 3 percent slope desirable. Utility-scale PV requires approximately 4 acres/MW of capacity for crystalline silicon.[5] Thin film and tracking technologies require more land, for example, 10 acres/MW in the case of Nellis AFB.

Water Use:
In contrast to the solar thermal technologies, PV installations do not require water for electricity generation. Depending on the location of individual projects, some water may be required to wash the panels to maintain efficiency. No permits have been submitted in CA, but some companies have indicated that between 2-10 acre-ft/year of water per 100 MW might be needed. For comparison, one acre-ft/year provides enough water for three to six families in California.[6]

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[1]Renewable Energy Access, "Construction Complete on 6 MW Thin-Film PV Installation in Germany," April 5, 2007. Available at: www.renewableenergyaccess.com/rea/news/story?id=48027
[2]Ontario Power Authority, Standard Offer program, January 2008 Progress Report. Available at: http://www.powerauthority.on.ca/SOP/Page.asp?PageID=122&ContentID=6455&SiteNodeID=308
[3]Advice 2198-E, SCE submission to CPUC, December 31, 2007. Available at: www.sce.com/NR/sc3/tm2/pdf/2198-E.pdf
[4]PR Newswire. "PG&E adds utility-scale solar projects to its power mix". Available at: http://sev.prnewswire.com/oil-energy/20070627/AQW07227062007-1.html
[5]The Guardian, "Portugal Plans Biggest Solar Station" Sept 15, 2005. Available at: http://www.guardian.co.uk/environment/2005/sep/15/energy.renewableenergy
[6]Mary E. Renwick and Richard D. Green, Journal of Environmental Economics and Management 40, 37.55 (2000)

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